TED06 – (Part E10) Smog for HL

Name _____

1. E.10.1 State the source of primary pollutants and the conditions necessary for the formation of photochemical smog. (1) *VOCs and NOx, temperature inversion, windlessness and bowl-shaped cities should be discussed.*
    a. What is the difference between what was originally considered smog and what we now consider photochemical smog?

    b. What cities are affected by the presence of photochemical smog? Why do you think?

    c. List the primary pollutants of photochemical smog:

    d. List the secondary pollutants of photochemical smog:

    e. What is the inversion layer, where is it found, what is it caused by, and what layers (picture) are present?

2. E.10.2 Outline the formation of secondary pollutants in photochemical smog. (2) *Examples include NO_2, O_3, aldehydes and peroxyacylnitrates (PANs). The role of free radicals and sunlight should be\ emphasized.* ***Aim 7:*** *Three-dimensional and four-dimensional GIS techniques and data banks can be used.*
    a. What are the pollutants from photochemical smog?

    b. Provide the equation for the formation of NO_2 from NO:

    c. Provide the equation for the formation of ozone (cycle):

        i. Why does this process not always cycle through and deplete and form ozone in the same ratio?

    d. Hydrocarbons react with radical products of ozone formation to produce alkyl radicals, provide the set of equations to support this:

e. These alkyl radicals react further with oxygen and nitrogen monoxide radicals to add a primary oxygen and also form nitrogen dioxide radicals, provide a set of equations to support:

f. The resulting $RCH_2O\bullet$ radicals can react with di-oxygen molecules to form aldehydes, RCHO, show this:

g. These radicals convert NO to NO_2, which then photolyzes to form ozone

$\bullet OH + RCH_3 + 2O_2 + 2NO\bullet \rightarrow H_2O + RCHO + 2NO_2\bullet + \bullet OH$

i. Combined with

$2NO_2 + 2hf + 2O_2 \rightarrow 2NO\bullet + 2O_3$

ii. Results in:

$OH + RCH_3$ (need $NO + O_2$) $\rightarrow H_2O + RCHO + 2O_3 + \bullet OH$

h. Explain how the concentration of NO and NO_2 change during peak hours of traffic in polluted cities:

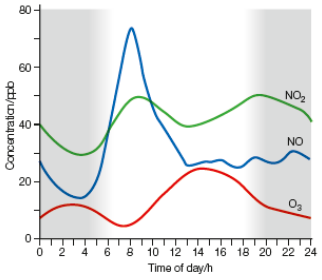

Figure 25.37 Variation of the concentrations of ozone and oxides of nitrogen on a summer weekday in London

i. What does ozone do to synthetic materials?

j. PAN (peroxyacyl nitrate) compounds remove NO_2 from photochemical smog; provide equations to support this process.

k. How do PAN molecules aid in the transportation of ozone producing compounds?